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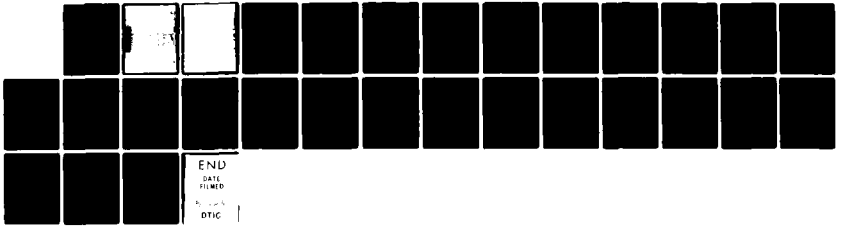
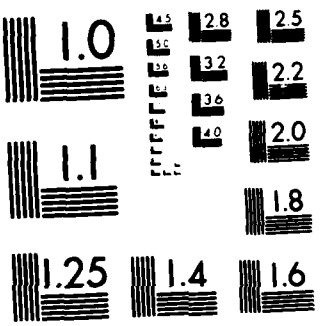
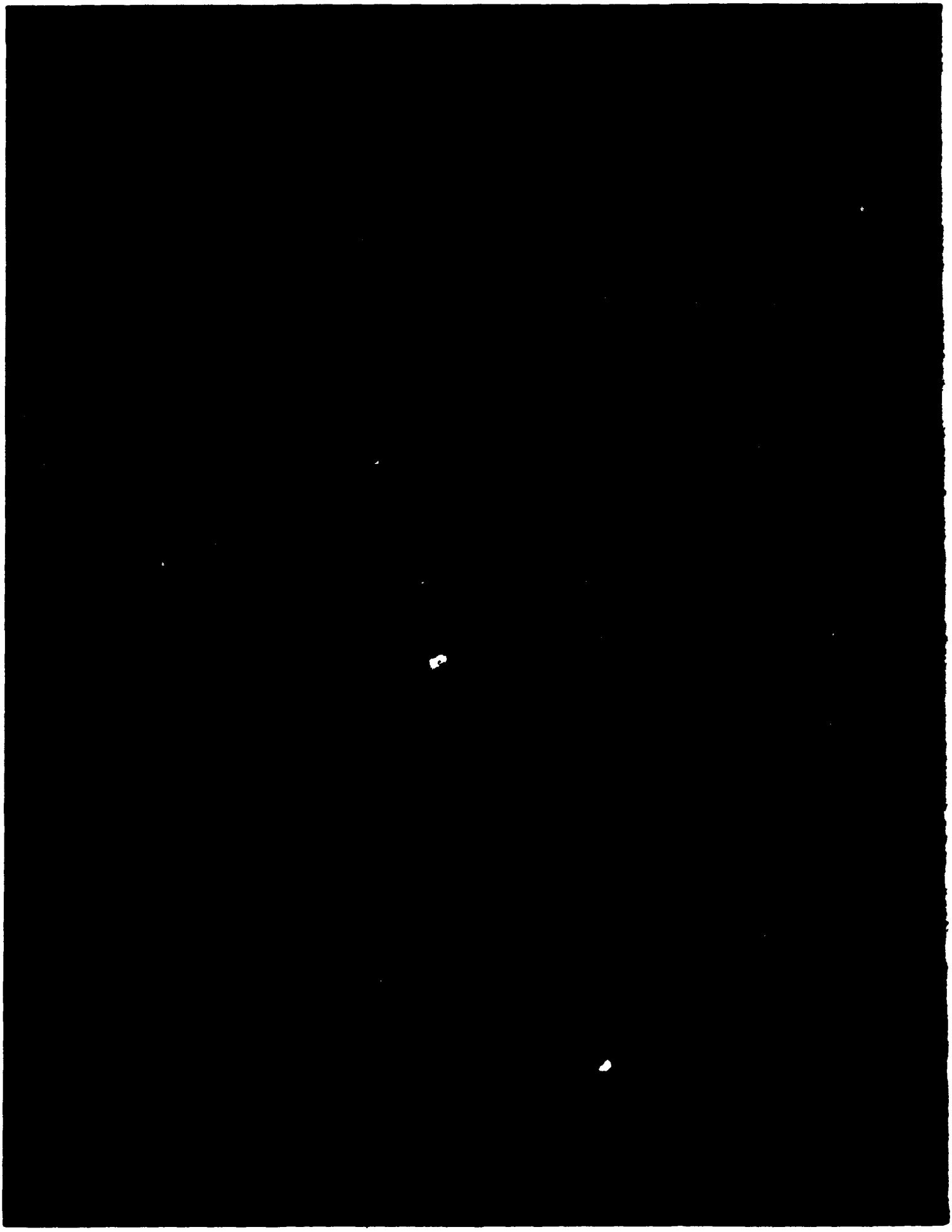






MASSACHUSETTS INSTITUTE OF TECHNOLOGY

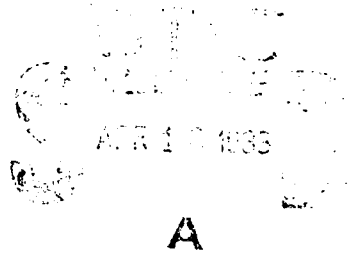
LINCOLN LABORATORY

ADVANCED ELECTRONIC TECHNOLOGY

QUARTERLY TECHNICAL SUMMARY REPORT TO THE AIR FORCE SYSTEMS COMMAND

1 AUGUST — 31 OCTOBER 1982

ISSUED 19 JANUARY 1983



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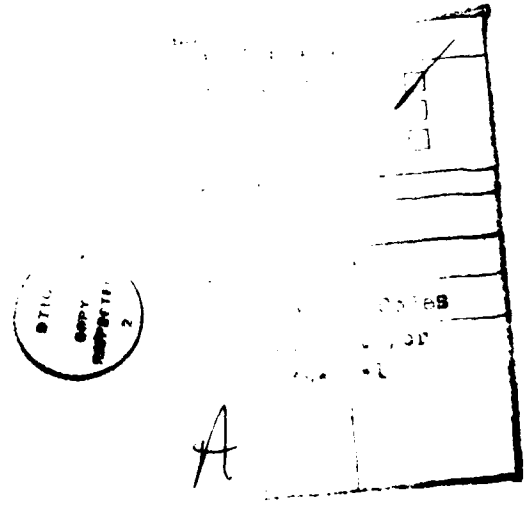
INTRODUCTION

This Quarterly Technical Summary covers the period 1 August through 31 October 1982. It consolidates the reports of Division 2 (Data Systems) and Division 8 (Solid State) on the Advanced Electronic Technology Program.



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DATA SYSTEMS

DIVISION 2

INTRODUCTION

This section of the report reviews progress during the period 1 August through 31 October 1982 on Data Systems. Separate reports describing other work of Division 2 are issued for the following programs:

Seismic Discrimination	ARPA/DSO
Distributed Sensor Networks	ARPA/IPTO
Defense Switched Network Technology	OSD-DCA
Digital Voice Processing	AF/ESD
Digital Voice Interoperability Program	AF/ESD
Packet Speech Systems Technology	ARPA/IPTO
Radar Signal Processing Technology	ARMY/BMDATC
Restructurable VLSI	ARPA/IPTO
Multi-Dimensional Signal Processing	AF/RADC

A.J. McLaughlin
Head, Division 2

T. Bially
Associate Head

DIGITAL INTEGRATED CIRCUITS
GROUP 23

I. INTRODUCTION

The designs of both the multiply-accumulator and parallel-serial cells for the 16-point FFT have been verified by successful operation of fabricated circuits of both types. First samples of a new metal gate, self-aligned nitride MOSFET have been fabricated and operated satisfactorily.

II. RVLSI CIRCUITS

A. Phase 0 Integrator

The whole-wafer demonstration experiment using the Phase 0 integrator has been operated on the Tektronix 3260 and a program written to simulate the operation as an integrator with incoming data comprising a signal peak varying slowly in time surrounded by random noise. This gives a clear demonstration of the averaging capability of the circuit. Operation is limited to about 1 MHz due to the high capacitance built into this design by the full complement of unused links.

B. RVLSI Spread-Spectrum Integrator

The whole-wafer RVLSI spread-spectrum integrator design has been completed through layer 7, contact cuts. Reticles were ordered and received, and several runs are now being fabricated. Design of first-level metal and above has been completed using results from assignment and linking simulation to determine the detailed placement of laser programmable links. The algorithms for finding signal paths (linking) are rather simple and oriented toward the type of nets found in these two systems; i.e., 2-point and bus. The physical nets can be displayed on a color terminal and it is possible to manually intervene in the assignment and linking. The interconnect for the

integrator has been designed for redundancy, minimization of capacitance load, and matching to the linking algorithms. As a result of our experience with the Phase 0 wafer, all tracks have been provided with probe pads for capacitance measurements. The first set of 3-in. wafers in fabrication has progressed to the polysilicon level. The array comprises 16 × 12 cells, each containing four 10-bit counters, which for the required 64 gives a redundancy of 200 percent. This wafer will have input and output buffers at the wafer periphery. A two-level distribution system for the 25-MHz clock will be used and SPICE simulations show this speed should be achieved with worst-case fabrication parameters. These wafers will be packaged in 2.25-in. square packages of the type usually used for hybrid circuits.

C. FFT for Radar Applications

The cell designs for the 16-point FFT have now been verified by successful fabrication of working circuits. The two most recently processed wafers contain working devices of both cell types. One wafer has 12 (out of a possible 64) functional multiply-accumulate circuits and 2 (out of a possible 32) functional parallel-serial converter circuits. The other wafer has 19 and 0, respectively.

The multiply-accumulate circuit has worked at a clock frequency as high as 15 MHz; the goal is 16 MHz. The failure at high frequency, however, is caused by the inability of the circuit outputs to drive the 80-pF load presented by the Tektronix tester, and not by internal circuit failure. Tests in which this capacitive loading is reduced are pending. The Tektronix S3260 has proved indispensible in obtaining test data on both the FFT cells, the Phase 1 cell, and the Phase 0 demonstration wafer.

III. RESTRUCTURABLE VLSI TECHNOLOGY

A. RVLSI Laser Links

Most of the laser linking studies this past month have concentrated on the life tests described below. One failure mode has been observed, the

tendency at high laser powers (about 3 W) for the link to create a diode-like contact to the substrate. Experiments to study this further are being pursued.

The thin oxide barriers on the amorphous silicon linking material, while quite usable, do present certain restrictions on the processing of the wafer. To eliminate these several other barriers are being studied. The most successful one to date has been thin (0.05 to 0.1 μm) molybdenum barriers. The molybdenum provides good barrier protection for the 450°C, half-hour sinter required for CMOS processing. In addition over 3000 links have been successfully produced with these structures. They show the same wide power window as regular links; connections were made with no failures in the 1.4- to 4.0-W range. Link resistances were very low for both thicknesses, typically 0.3 ohms on small structures (20-μm square pads).

B. Laser Link Lifetime Experiments

In the electromigration studies of the laser links voltage contrast SEM photos have been used to locate all the break points on the failures mentioned in the last Quarterly Technical Summary.* In all cases the laser link continued to function; only the metal bus lines leading up to it were found to fail. Also, a new long-term study was started using 21 links with 50 mA of current flowing through them (the ambient temperature was 115°C, but the heat generated on the chips raised the substrate to 150°C). With about 1190 hr of testing completed to date, there have been 8 failures: 1 after 60 hr, 2 at 200 hr, 2 at 600 hr, and 3 at 1100 hr. Visual inspection of these samples has not yet allowed location of the failure points.

The important point to note in these results is the rather long time before failure of any links. This suggests that the current in the link is

*Advanced Electronic Technology Quarterly Technical Summary, Lincoln Laboratory, M.I.T. (15 August 1982).

not being carried by fine filaments of aluminum (which would burn out very quickly at these current levels) but rather by the Si-Al mixture which occurs throughout the link volume.

C. Polyimide Lateral Laser Links

Polyimide links have been produced using a single zap with a low-powered objective lens to create a 40-μm-dia. conducting circle. Not only is this much faster to produce than the previous multiple shot pattern, but resistance tends to be lower (in the 600-ohm range). About 700 such links have been produced to date, with good repeatability and reliability on one wafer. More such tests are continuing.

It has long been known that polyimide chars at about 700°C, producing a conductive film of carbon islands in a plastic matrix. However, the resistivity of such materials is about 10 ohm-cm. Tests on 400-μm-long lines of zapped polyimide show resistivities in the 0.1- to 0.01-ohm-cm range. This suggests the material is being converted to an almost pure carbon film. Auger analysis of the samples confirms this by showing mostly carbon, with a small bit of oxygen, in the link, and no nitrogen. By comparison, similar tests on 700°C samples show significant amounts of N. This is consistent with some studies in the literature which show that if polyimide is raised above 1000°C all nitrogen is lost, and "glassy carbon" sheets are formed. Studies are continuing to further characterize these links.

D. Polysilicon Lateral Links

Further evaluation of polysilicon lateral links* has been carried out. These experiments were done with the laser table under the control of a

*Advanced Electronic Technology Quarterly Technical Summary, Lincoln Laboratory, M.I.T. (15 February 1982), DTIC AD-A118869.

computer, to simulate the linking process of a RVLSI wafer. The linking characteristics were found to vary from wafer to wafer (46- to 80-percent links were below 5 ohms). This may arise from initial alignment errors and the positioning accuracy of the table. Better results (85-percent links less than 5 ohms) were obtained when a larger laser spot was used (20X objective instead of 50X). An analysis of bad links in both of these experiments shows that most of these were attributable to mispositioning.

E. Optical Probing of RVLSI Nets

A simple technique has been developed for probing laser formed nets on RVLSI wafers. For those nets which are connected to the outside world, the technique consists of measuring the I-V curve of various cell diodes under optical illumination. This is carried out by shining laser pulses on input protect diodes (output transistors) for various input (output) pads hooked to the net and recording the I-V curve of the net with and without optical illumination. An analysis of these curves then allows determination of the resistance of different parts of the net for resistances of >500 ohms.

Internal nets going from one cell to another can also be probed to a limited extent provided that the two cells hook up to different V_{SS} buses. In this measurement the voltage induced at one end of the net is measured while light pulses are incident on the other end. This is done by looking at the V_{SS} bus which would connect to the unstimulated end of the net through a back-biased diode (with V_{DD} ground). This technique has been used to give a qualitative idea of the resistance of internal nets and is being developed to obtain more accurate estimates.

IV. SEMICONDUCTOR PROCESSING

A. Lithography

It has become clear that photoresist residues on wafers after development are responsible for variability in plasma etching processes.

Using an O_2 plasma etch to remove a controlled amount of photoresist as a pre-plasma etch step seems to provide more uniform results. Also, alternative positive photoresists are being tested to learn whether cleaner surfaces after development are attainable.

B. Dry Etching

Polysilicon etching with Freon 13 has been found to produce excessive undercut and linewidth variability across the wafer. Freon 115 provides a much more anisotropic etch and is therefore now being used for plasma etching of polysilicon. The installation of a rotary plasma reactor has improved across-wafer etching uniformity and increased etching throughput significantly. Additional such reactors are under construction for other process steps.

Aluminum and aluminum-silicon-copper alloy etching have been significantly improved. A pre-metal argon sputter clean increases etch rate substantially. Modifications to the reactor geometry, addition of pure chlorine to the BCl_3 etch gas and installation of a DC bias have improved both etch rate and uniformity. The combination of these changes increased etch rate from 500 Å/min. to 2200 Å/min. and improved across-wafer etching uniformity so that maximum conductor width variation is less than 0.25 μm. Also, this process produces very clean SiO_2 and metal surfaces. Finally it has been found that the use of SF_6 plasma in the same reactor immediately following the BCl_3 metal etch eliminates the need for a water rinse to prevent metal corrosion caused by chlorine residue.

C. Polyimide Masking

Process modifications are being made to assure integrity of polyimide insulation between double-level metal interconnect. Catastrophic thinning of first photoresist and then polyimide at the top of surface features coupled with variability in photoresist etch rate in O_2 plasma had led to

inter-metal shorting. This problem appears to be solved by the use of a non-eroding metal mask process which consists of 3000 Å of photoresist covered with 400 Å of aluminum on top of which is then placed 10,000 Å of imaging resist. Here the aluminum mask is wet etched after the imaging resist has been processed, and O_2 plasma is used to etch through the thin resist and underlying polyimide. The aluminum mask is then lifted off by soaking in acetone which strips the thin, underlying resist layer. This process produces polyimide insulation of very high integrity over substantial (14,000 Å) surface topography and is exceedingly tolerant of overetch.

D. Two-Level Metal Process

Experiments with the inter-metal via process have continued, with the goal of repeating and improving on the good via chain results described in the August Quarterly Technical Summary. At that time, a via chain yield (168 vias per chain) of 99 percent for 6- × 6-μm vias and 94 percent for 4- × 4-μm vias was obtained, with 1 to 2Ω median single via resistance. These results were obtained with MF312 glint and no first-metal sinter, and Al-Si-Cu metallization for both conductor levels. Subsequent experiments have shown that the type of first-metal heat treatment is one of the key parameters in obtaining reliable inter-metal contact. The best and most consistent results to date have been obtained using no first-metal sinter and either a MF312 glint or an argon sputter clean immediately before second-metal deposition. After second metal is defined, a final 425°C sinter may be performed without degrading contact performance. In recent tests using this approach, a via chain yield of 100 percent for 4- × 4-μm vias and 90 percent for 3- × 3-μm vias has been obtained. Experiments are continuing to determine the effect of sintering as well as other important processing parameters.

E. CMOS Processing

A plasma-enhanced chemical vapor deposition (PECVD) system has been installed and debugged. It will be used to develop a link fabrication process where the oxide, a-Si, oxide structure can be deposited sequentially in the system without breaking vacuum. Processes for deposition of a-Si and silicon dioxide have been established using silane and silane plus nitrous oxide, respectively. The insulation and linking characteristics of the a-Si films have been evaluated and found to be at least comparable to RF-sputter deposited a-Si. A major difference between the two deposition techniques is a greater amount of hydrogen contained in PECVD films. Since heat treatments above the PECVD temperature, 300°C, evolve hydrogen, processing after deposition of the link structure requires slow heating cycles to avoid rapid evolution of that hydrogen which can cause local delamination of the film. Modifications in the deposition process are being evaluated to minimize hydrogen entrapment during deposition.

V. DEVICE THEORY

A. Nitrided Oxides

Preliminary measurements indicate it will be possible to resolve CVD nitride IR spectra into the same group of oscillators found in crystalline silicon nitride. This unambiguously demonstrates, for the first time, that the CVD nitride consists of SiN_4 tetrahedra trigonally bonded. We expect that in turn the nitrided oxide spectra will demonstrate the nature of oxygen and nitrogen bonds in this material.

B. Self-Aligned Channel Transistor

A metal-gate MOSFET which uses thin nitride to provide self-alignment between gate dielectric and diffusion has been fabricated. Transistors with

gate lengths down to a little over 1 μm have been operated satisfactorily. Detailed measurements of mobility, channel length, and gate overlap capacitance are in progress.

COMPUTER SYSTEMS

GROUP 28

The UNET system, acquired from 3COM Corporation to provide a software interface between UNIX and the new ARPANET TCP/IP protocol, continues under test in a DEC PDP-11/44. Limited connections to other hosts already testing the new protocol have been completed and will be further exercised during scheduled netwide experiments. The software connecting UNIX to the Lincoln Internal Data Link (LIDL) and, in turn, connecting LIDL to the VM/370 Operating System on the Amdahl V/8, is awaiting a few modifications and final testing. The entire PDP-11/44 gateway should be complete for the 1 January 1983 "TCP-only" deadline.

User education is being addressed in several different areas. The first edition of a periodic Computer Center Newsletter has been published and a second edition is already in preparation. A six-lecture course on the Statistical Analysis System (SAS) is in progress in the Laboratory-sponsored Education Program. Like most courses of this type, the SAS lectures are being video taped for future reruns. A committee has been formed to review and update previously developed video tapes that can be collected into a series to be called "Introduction to the Central Computer Facility."

Both the time-sharing (VM/370) and batch processing (VS1) workloads have increased noticeably during the quarter, supporting usage estimates made earlier. In addition, there has been a joint planning effort with current users of a Laboratory CDC 6600 computer, for the transition of that workload to the Amdahl V/8. The transition will begin early in 1983 and be completed by September. In order to handle the impact of these increases on V/8 loading, a committee has been working to consider means to upgrade Central Facility processing power. As an initial step, an RFI is being prepared to acquire a compatible Adjunct Computer during the spring of 1983. Although its first role will be to assist with the batch processing, it is expected that it may also be used for time-sharing. Planning and study for a second step in upgrading the facility continues in parallel.

SOLID STATE

DIVISION 8

INTRODUCTION

This section of the report summarizes progress during the period 1 August through 31 October 1982. The Solid State Research Report for the same period describes the work of Division 8 in more detail. Funding is primarily provided by the Air Force, with additional support provided by the Army, DARPA, Navy, NASA, and DOE.

A. L. McWhorter
Head, Division 8

I. Melngailis
Associate Head

DIVISION 8 REPORTS

ON ADVANCED ELECTRONIC TECHNOLOGY

15 August through 15 November 1982

PUBLISHED REPORTS

Journal Articles

JA No.			
5184	The Nature of the Initial Transient in the Rate of Formation of Nickel Carbonyl	H. Mazurek* R.S. Mehta* M.S. Dresselhaus* G. Dresselhaus* H.J. Zeiger	Surf. Sci. 118, 530 (1982)
5313	Transient Annealing of Selenium-Implanted Gallium Arsenide Using a Graphite Strip Heater	R.L. Chapman J.C.C. Fan J.P. Donnelly B-Y. Tsaur	Appl. Phys. Lett. 40, 805 (1982)
5335	Pulse-Pumped Operation of Divalent Transition-Metal Lasers	P.F. Moulton	IEEE J. Quantum Electron. QE-18, 1185 (1982)
5343	Quantum Electronics at Lincoln Laboratory	P.L. Kelley	Laser Focus 18, 28 (August 1982) and 18, 32 (September 1982)
5346	Low-Dislocation-Density GaAs Epilayers Grown on Ge-Coated Si Substrates by Means of Lateral Epitaxial Overgrowth	B-Y. Tsaur R.W. McClelland J.C.C. Fan R.P. Gale J.P. Salerno B.A. Vojak C.O. Bozler	Appl. Phys. Lett. 41, 347 (1982)
5347	High-Speed Ultraviolet- and X-Ray-Sensitive InP Photoconductive Detectors	T.F. Deutsch F.J. Leonberger A.G. Foyt D. Mills*	Appl. Phys. Lett. 41, 403 (1982)
5352	Graphoepitaxy of Germanium on Gratings with Square-Wave and Sawtooth Profiles	M.W. Geis B-Y. Tsaur D.C. Flanders	Appl. Phys. Lett. 41, 526 (1982)
5354	Deep-Ultraviolet Spatial-Period Division Using an Excimer Laser	A.M. Hawryluk* H.I. Smith* R.M. Osgood* D.J. Ehrlich	Opt. Lett. 7, 402 (1982)
5361	Limitations of Signal Averaging Due to Temporal Correlation in Laser Remote-Sensing Measurements	N. Menyuk D.K. Killinger C.R. Menyuk*	Appl. Opt. 21, 3377 (1982)
5362	Analysis of Integrated-Optics Near 3 dB Coupler and Mach-Zehnder Interferometric Modulator Using 4-Port Scattering Matrix	R.H. Rediker F.J. Leonberger	IEEE J. Quantum Electron. QE-18, 1813 (1982)
5365	Simultaneous Formation of a Shallow Silicon p-n Junction and a Shallow Silicide/Silicon Ohmic Contact by an Ion Implantation Technique	B-Y. Tsaur C.H. Anderson	Appl. Phys. Lett. 41, 877 (1982)

* Author not at Lincoln Laboratory.

JA NO.			
5369	Spatial Light Modulation Using Electroabsorption in a GaAs Charge-Coupled Device	R.H. Kingston B.E. Burke K.B. Nichols F.J. Leonberger	Appl. Phys. Lett. 41, 413 (1982)
5370	Lateral Epitaxial Overgrowth of GaAs by Organometallic Chemical Vapor Deposition	R.P. Gale R.W. McClelland J.C.C. Fan C.O. Bozler	Appl. Phys. Lett. 41, 545 (1982)
5377	Time-Resolved Measurements of Stimulated Surface Polariton Wave Scattering and Grating Formation in Pulsed-Laser-Annealed Germanium	D.J. Ehrlich S.R.J. Brueck J.Y. Tsao	Appl. Phys. Lett. 41, 630 (1982)
5378	2-Bit 1 Gsample/s Electrooptic Guided-Wave Analog-to-Digital Converter	R.A. Becker F.J. Leonberger	IEEE J. Quantum Electron. QE-18, 1411 (1982)
5388	Orientation Selection by Zone-Melting Silicon Films Through Planar Constrictions	H.A. Atwater* H.I. Smith* M.W. Geis	Appl. Phys. Lett. 41, 747 (1982)

Meeting Speeches

MS No.			
5766	Effects of Interface Structure on the Electrical Characteristics of PtSi-Si Schottky Barrier Contacts	B-Y. Tsaur D.J. Silversmith R.W. Mountain C.H. Anderson, Jr.	Thin Solid Films 93, 331 (1982)
5891	Dry Etching of Gold Using SF_6	S.M. Cabral M.E. Elta A. Chu L.J. Mahoney	The Electrochemical Society Extended Abstracts 82-1, Montreal, Canada, 9-14 May 1982, Abstract 216, p. 348
5892	Orientation Selection by Zone-Melting Silicon Films Through Planar Constrictions	H.I. Smith* H.A. Atwater* M.W. Geis	The Electrochemical Society Extended Abstracts 82-1, Montreal, Canada, 9-14 May 1982, Abstract 159, p. 257
5893	The Mechanism of Orientation of Si Graphoepitaxy Using a Strip-Heater Oven	H.I. Smith* M.W. Geis	The Electrochemical Society Extended Abstracts 82-1, Montreal, Canada, 9-14 May 1982, Abstract 155, p. 249
6023A	Si Damage Induced by Dry Etching	S. Pang D.D. Rathman D.J. Silversmith R.W. Mountain P.D. DeGraff	The Electrochemical Society Extended Abstracts 82-2, Detroit, Michigan, 17-22 October 1982, Abstract 184, p. 289

* Author not at Lincoln Laboratory.

UNPUBLISHED REPORTS

Journal Articles

JA No.			
5334	Metal/Si and Silicide/Si Interfaces	B-Y. Tsaur J.M. Mayer*	Accepted as Chapter in Ion-Beam-Induced Silicide Formation (McGraw Hill, New York)
5357	A Two-Stage Monolithic IF Amplifier Utilizing a Ta_2O_5 Capacitor	A. Chu L.J. Mahoney M.E. Elta W.E. Courtney M.C. Finn W.J. Piacentini J.P. Donnelly	Accepted by IEEE Trans. Microwave Theory Tech.
5375	Be-Implanted GaInAsP/InP Double Heterojunction Laser Diodes	J.P. Donnelly J.N. Walpole Z.L. Liau	Accepted by IEEE J. Quantum Electron.
5383	External Cavity Controlled Operation of a Semiconductor Diode Gain Element in Series with an Optical Fiber	R.H. Rediker R.P. Schloss D. Welford A. Mooradian	Accepted by IEEE J. Quantum Electron.
5386	High-Voltage Two-Dimensional Simulations of Permeable Base Transistors	G.D. Alley	Accepted by IEEE Trans. Microwave Theory Tech.
5390	Transmission Electron Microscopy of GaAs Grown over Submicrometer Period Tungsten Gratings	R.A. Vojak J.P. Salerno	Accepted by Appl. Phys. Lett.
5392	Rate of Ethylene Hydrogenation on $Ni_{1-x}Cu_x$ Catalysts - Effects of Magnetic Ordering	H.J. Zeiger R. Wasserman* M.S. Dresselhaus* G. Dresselhaus*	Accepted by Surf. Sci.
5406	Thin-Film Transistors Fabricated in Solid-Phase-Recrystallized Si Films on Fused Silica Substrates	B-Y. Tsaur J.C.C. Fan G.W. Turner M.W. Geis D.J. Silversmith R.W. Mountain	Accepted by J. Appl. Phys.
5407	SOI/CMOS Circuits Fabricated in Zone-Melting-Recrystallized Si Films on SiO_2-Coated Substrates	B-Y. Tsaur J.C.C. Fan R.L. Chapman M.W. Geis D.J. Silversmith R.W. Mountain	Accepted by IEEE Electron Devices Lett.
5411	IR Detectors: Heterodyne and Direct	D.L. Spears	Accepted for publication in special issue of collected papers in Optical and Laser Remote Sensing (Springer-Verlag, New York)
5415	Q-Switched Semiconductor Diode Lasers	D.Z. Tsang J.N. Walpole	Accepted by IEEE J. Quantum Electron.

* Author not at Lincoln Laboratory.

Meeting Speeches*

MS No.			
5707I	Laser Fabrication of Microstructures: Physical Mechanisms of High Resolution Processing	D.J. Ehrlich J.Y. Tsao	1982 Annual Mtg. of Materials Research Society, Boston, 1-4 November 1982
6081	UV Laser Initiated Formation of Si_3N_4	T.F. Deutsch D.J. Silversmith R.W. Mountain	
6084	Submicrometer-Linewidth Laser Doping	J.Y. Tsao D.J. Ehrlich	
6087	Surface Electromagnetic Waves in Laser Material Interactions	D.J. Ehrlich S.R.J. Brueck J.Y. Tsao	
6092	Optical Microanalysis of Small Semiconductor Structures	D.V. Murphy S.R.J. Brueck	
6108	Pulsed Laser Doping of Semiconductors	T.F. Deutsch	
6187	Applications of Laser Direct-Write Processes to Electronic Device Fabrication	J.Y. Tsao D.J. Ehrlich D.J. Silversmith R.W. Mountain	
5905A	Photorefractive Effects in Optical Waveguides	A. Lattes† H.A. Haus† F.J. Leonberger	Electronics Division, American Ceramic Society, Cambridge, Massachusetts, 14 September 1982
6059	$LiNbO_3$ Guided-Wave Interferometric Modulators	F.J. Leonberger	
5934	Thin Films of III-V Compounds and Their Applications	J.C.C. Fan	CNRS Intl. Colloq. on Polycrystalline Semiconductors, Perpignan, France, 2-4 September 1982
5943A	Progress in Laser Sources for Remote Sensing	A. Mooradian P.F. Moulton N. Menyuk	1982 Mtg. of IRIS Specialty Group on Active Systems, White Oak, Silver Spring, Maryland, 7 October 1982
5949	Reduction of Photovoltaic Cell Reverse Breakdown by Using a Peripheral Bypass Diode	C.H. Cox D.J. Silversmith R.W. Mountain	16th IEEE Photovoltaic Specialists Conf., San Diego, California, 28 September - 1 October 1982
5972	Growth and Characterization of Oriented GaAs Bicrystal Layers	J.P. Salerno R.W. McClelland J.C.C. Fan P. Vohl C.O. Bozler	
5999	Efficient GaAs/Ge/Si Solar Cells	B-Y. Tsaur J.C.C. Fan G.W. Turner F.M. Davis R.P. Gale	

* Titles of Meeting Speeches are listed for information only. No copies are available for distribution.

† Author not at Lincoln Laboratory.

MS No.			
6002	Junction Formation in GaAs Shallow-Homojunction Solar Cells by the Use of Spin-On Diffusion Sources	G.W. Turner B-Y. Tsaur J.C.C. Fan F.M. Davis R.P. Gale M.K. Connors	16th IEEE Photovoltaic Specialists Conf., San Diego, California, 28 September - 1 October 1982
6008	Optimal Design of High-Efficiency Tandem Cells	J.C.C. Fan B-Y. Tsaur B.J. Palm	
5976B	Entrainment of Subboundaries in Zone-Melting Recrystallized Si Films	M.W. Geis H.I. Smith* B-Y. Tsaur J.C.C. Fan D.J. Silversmith R.W. Mountain	1982 SOS/SOI Technology Workshop, Provincetown, Massachusetts, 5-7 October 1982
6118	Zone-Melting Recrystallization of Si Films on Insulators for Integrated Circuit Applications	B-Y. Tsaur J.C.C. Fan M.W. Geis R.L. Chapman G.W. Turner D.J. Silversmith R.W. Mountain	
6017	Millimeter Wavelength GaAs Permeable Base Transistors	G.D. Alley C.O. Bozler N.P. Economou D.C. Flanders M.W. Geis G.A. Lincoln W.T. Lindley R.W. McClelland R.A. Murphy K.B. Nichols W.J. Piacentini S. Rabe J.P. Salerno B.A. Vojak	Device Research Conf., Colorado State University, Ft. Collins, Colorado, 21-23 June 1982
6034	MeV Ion Implanted Boron Layers in Silicon	E.W. Maby	Ion Beam Modification of Materials Conf., Grenoble, France, 6 September 1982
6051	Q-Switched Semiconductor Diode Lasers	D.Z. Tsang J.N. Walpole	8th Annual Intl. Semiconductor Laser Conf., Ottawa, Canada, 15 September 1982
6054	GaInAsP/InP Heterostructure Laser Mirrors Formed by a Transport and Etching Technique	Z.L. Liau J.N. Walpole	
6067	Laser Photochemical Processing for Microelectronics	D.J. Ehrlich T.F. Deutsch R.M. Osgood, Jr.* D.J. Silversmith	Intl. Conf. on Solid State Devices, Tokyo, Japan, 24-26 August 1982

* Author not at Lincoln Laboratory.

MS No.			
6078	Excitation of Surface Optical Waves and Material Ripples by Stimulated Scattering	S.R.J. Brueck D.J. Ehrlich J.Y. Tsao	1982 Annual Mtg. of Optical Society of America, Tucson, Arizona, 18-22 October 1982
6088	Laser Photochemistry in Adsorbed Surface Layers	J.Y. Tsao V. Daneu D.J. Ehrlich	
6085	Lateral Epitaxial Overgrowth of GaAs and GaAlAs by Organo-metallic Chemical Vapor Deposition	R.P. Gale R.W. McClelland J.C.C. Fan C.O. Bozler	1982 Intl. Symp. on GaAs and Related Compounds, Albuquerque, New Mexico, 19-22 September 1982
6095	RF Magnetron Sputtering of ZnO for SAW: Effects of Magnetic Field Strength and Configuration	A.C. Anderson D.E. Oates	1982 Ultrasonics Symp., San Diego, California, 27-29 October 1982
6096	Adaptive CW Filtering by Chirp Transformation Using Overlap Summation	D.R. Arsenault	
6097	Wideband Analog Signal Processing with Superconductive Circuits	S.A. Reible	
6106	Preparation of High-Quality Silicon Films on Insulators by Zone-Melting Recrystallization	J.C.C. Fan	Seminar, Centre National d'Etudes des Telecommunications, Grenoble, France, 6 September 1982
6109	Crystal Growth and Characterization of HEM-Grown Co:MgF_2 for Laser Application	C.P. Khattak* F. Schmid* P.F. Moulton	Big Sky Laser Conf., Big Sky, Montana, 17-19 August 1982
6110	Advanced SAW-Based Signal Processing for Packet Communications	J.H. Cafarella	1982 MILCOM Conf., MITRE Corporation, Bedford, Massachusetts, 17-20 October 1982
6112	Single Mode Waveguide Submillimeter Frequency Multiplication and Mixing	N.R. Erickson* H.R. Fetterman	4th High Temperature Plasma Diagnostics Topical Conf., M.I.T., 25-27 August 1982
6114	Integrated Optical Devices for Temperature Sensing	L.M. Johnson F.J. Leonberger G.W. Pratt, Jr.*	1st Intl. Congress on Applications of Lasers and Electrooptics, Boston, 23 September 1982
6124	High Resolution Parallel Transfer Lithography	D.C. Flanders	SEMICON East, Boston, 22 September 1982
6136	Low-Threshold Heterostructure Lasers	J.N. Walpole Z.L. Liau	Triservice Workshop on Fiber Optic Sensors and Guided Wave Technology, Ft. Eustis, Virginia, 7 October 1982
6140	An Investigation of GaAs Films Grown by MBE at Low Substrate Temperatures and Growth Rates	G.M. Metze A.R. Calawa	4th Annual Molecular Beam Epitaxy Workshop, Urbana, Illinois, 21-22 October 1982

* Author not at Lincoln Laboratory.

MS No.			
6144	Lateral MBE Growth of GaAs over Tungsten	A.R. Calawa B.A. Vojak G.M. Metze M.J. Manfra W.D. Goodhue	4th Annual Molecular Beam Epitaxy Workshop, Urbana, Illinois, 21-22 October 1982
6171	Optoelectronic Signal Processing Devices	F.J. Leonberger	Electron Device Activities in Western New York, Rochester, New York, 19 October 1982
6171A	Optoelectronic Signal Processing Devices	F.J. Leonberger	Seminar, University of Rochester, Rochester, New York, 18 October 1982
6180	Electrooptical Device Research at Lincoln Laboratory	F.J. Leonberger	Seminar, Bell Labs, Allentown, Pennsylvania, 26 October 1982
6182	Spectral Properties of Semiconductor Lasers	A. Mooradian	EECS/RLE Seminar Series on Optics and Quantum Electronics, M.I.T., 20 October 1982

SOLID STATE

DIVISION 8

I. SOLID STATE DEVICE RESEARCH

An electrooptic analog-to-digital converter has been demonstrated at 1 gigasample per second. This converter uses a $LiNbO_3$ Ti-indiffused waveguide interferometric array for conversion, a pulsed GaAlAs diode laser for sampling, a Si avalanche photodiode for detection of the sampled waveform, and a special 1-GHz Si integrated circuit for digital processing. Individual bit channels of this 2-bit device have been tested by a beat-frequency technique with a 499.2-MHz test signal. This represents the highest frequency conversion of an analog waveform reported to date.

The optical properties of the integrated optics Y-junction, which can function as a power combiner or power divider, and of the Mach-Zehnder interferometric modulator have been analyzed using the four-port scattering matrix. The interferometric properties of the Y-junction are found to be relatively insensitive to fabrication and design errors of a magnitude that would make the use of the Y-junction in the reverse direction as a 3-dB power divider very marginal.

P-type HgCdTe photoconductors operating at high temperatures have been investigated for wide-bandwidth (>100-MHz) heterodyne and direct detection at 10 μm. Measured 10.6-μm heterodyne sensitivities of 9×10^{-20} W/Hz at 195K and 1×10^{-17} W/Hz at 300K and direct sensitivity of 7×10^{-10} $W/Hz^{1/2}$ at 300K, which are in excellent agreement with a detailed theoretical analysis, are the highest observed for detectors in this temperature range.

II. QUANTUM ELECTRONICS

The $Ni:MgF_2$ and $Co:MgF_2$ transition metal laser systems have been mode-locked. Autocorrelation measurements give a pulse width of 21 ps for $Ni:MgF_2$ and 64 ps for $Co:MgF_2$.

Ultrashort optical pulses of 28 to 55 ps duration have been generated with a GaAlAs laser diode using gain-switched excitation. One of the diode facets was irradiated with protons in order to provide a region of saturable absorption.

Optoelectronic cross-correlation measurements have been made of the temporal response of proton-bombarded, interdigitated-electrode-structure InP photodetectors. Using a CW mode-locked dye laser producing 3-ps pulses, a typical full-width half-maximum (FWHM) response of 65 ps was found.

Optoelectronic switches have been fabricated from evaporated Si layers, and electrical pulses of less than 40-ps duration have been produced using ultrashort laser pulses for excitation. The switches exhibit a very low dark current and return to their high off-state resistivity in less than 50 ps.

The production of surface ripple structures on semiconductor materials by stimulated polariton scattering has been extended into the vacuum ultraviolet; ripple periods of 65 nm have been produced on Ge using a 157-nm F_2 laser source. The spectral dependence of the ripple period provides information on the optical properties of the dynamic liquid semiconductor layer formed during laser annealing.

The rotational temperature of expanding H_2O vapor has been measured with a heterodyne radiometer by observing the absorption of the 557-GHz transition against a hot background. A carcinotron at 279 GHz was used as the local oscillator in conjunction with a GaAs Schottky diode second-harmonic mixer.

III. MATERIALS RESEARCH

A complementary metal-oxide-semiconductor (CMOS) test circuit chip has been designed for evaluating silicon-on-insulator wafers prepared by using the graphite strip-heater technique for zone-melting recrystallization of polycrystalline Si films on SiO_2-coated Si substrates. High yields of good-quality transistor arrays and ring oscillators have been obtained for test chips fabricated on 2-in.-dia. wafers.

Films of GaAs with good electrical properties have been grown by molecular beam epitaxy at substrate temperatures as low as 380°C. The growth of such films, which has not been achieved previously at substrate temperatures below 500°C, was accomplished by reducing the growth rate.

The formation of high-quality p-n junctions in GaAs by diffusion from a spin-on source has been demonstrated. Small shallow-homojunction solar cells with conversion efficiencies of about 14 percent (AM1) have been fabricated by using the spin-on technique. With further development this technique may permit the simplified fabrication of high-efficiency cells by making it possible to obtain optimum junction depths without the need for thinning the n^+ layer.

IV. MICROELECTRONICS

A 16-stage GaAs Schottky-barrier CCD has been designed and fabricated for a demonstration of optical modulation of radiation near the GaAs bandgap edge. The illumination passes through semitransparent, 100-Å-thick Ti gates into the CCD, where optical absorption is dependent on the electric field in the CCD well and can be modulated by varying the charge content of the well. The required high pinch-off voltage combined with low leakage for the CCD is achieved by using a shallow, semi-insulating region formed by a low-energy proton bombardment at the surface of the CCD channel.

Silicon permeable base transistors have been fabricated which exhibit a maximum gain of 11 dB at 2 GHz and a maximum frequency of oscillation of 10 GHz. A deposited W film is used to form a Schottky-barrier base grid at the bottom of a 3200-Å-period etched square-wave groove structure in the Si, as well as the collector contacts at the Si finger tips.

Protection of photovoltaic modules from the "hot-spot" failure mode caused by cracking or shadowing of a single cell in a series string has been achieved by fabricating an isolated, narrow diode with low breakdown voltage around the periphery of the photovoltaic cell. The reverse bypass protection has been achieved both with a conventional diode at the periphery of the cell

connected in antiparallel and with a peripheral backward diode using standard interconnects.

V. ANALOG DEVICE TECHNOLOGY

Nonvolatile storage of analog signal levels has been demonstrated in discrete floating-gate memory cells. Signal charge tunnels from the p-silicon substrate through a thin silicon dioxide layer to an insulated island of polysilicon, where it is retained. These cells can be integrated with charge-coupled devices to provide integrated analog signal storage with retention times of months, better than that provided by dual-dielectric storage cells.

A new concept has been defined and experimentally verified which allows a surface-acoustic-wave chirp-transform adaptive filter system to approximate much more closely a true linear filter for CW inputs than was possible with conventional chirp-transform techniques. Transform systems operate on the input in time segments, a trait which in the past has created spurious segmentation artifacts in the output. The new method, which involves overlapping coherent summation of the time-segmented outputs to effectively cancel the artifacts, makes possible the use of such a system as an adaptive excisor of narrowband interference.

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